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16. ABSTRACT

A current effort of Caltrans is to develop an Excel-based tool to assist Caltrans in gradually deploying newly developed safety performance functions into the network screening processes. However, this future tool might not be compatible with data that originates from a Linear Reference System. In light of this, there is a need for the SPF Tool Enhancement project to further enhance the utility of the Excel tool by adding the capability to run the SPF Excel tool based on data from a Linear Reference System, and add functionality to compare the performance of different network screening methods.

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SPF Tool Enhancement

Final Technical Report

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Chapter 1. Introduction

To effectively manage the safety of transportation across the California state highway system (SHS), it is essential to continuously and systematically monitor the condition of the various infrastructure facility types (highway, intersection, and ramp), in addition to traffic volumes, and any reported traffic collisions. The California Department of Transportation (Caltrans) uses a centralized database—the Traffic Accident Surveillance and Analysis System (TASAS) Transportation Network System (TSN)—to document infrastructure assets, traffic volumes, and police-reported traffic collisions. However, there is no report providing information about the changes in the data structures that are being implemented through the Transportation System Network Replacement (TSNR) project. While the core database of TASAS-TSN contains data and attributes focused on motorized traffic and infrastructure, for previous studies ("Data Requirements for Safety studies" and "SPF Implementation study"), SafeTREC developed database formats and structures for infrastructure assets relevant to highway safety screening and future studies.

The purpose of this study is to develop recommended specifications for a data repository to consolidate infrastructure and collision data, in addition to data elements necessary for highway safety network screening and future research. The recommended specifications are compatible with both the existing TASAS-TSN database and the future GIS database structure known as TSNR, which is currently under development within Caltrans. SafeTREC developed the proposed module specifications after performing a review of previously collected data and determining which data are most accurate and beneficial for high priority safety and planning analysis. As part of this study, the authors developed a process to populate the proposed module, as well as a Microsoft Excel interface. Development of this system will allow Caltrans to better take advantage of existing data collection efforts for improving safety of the state highway system through network screening.

There are several documents/discussions on the TASAS-TSN system and the TSNR project including the following:

- Draft Transportation System Network Replacement project Road Map, which provides the schedules of the TSNR project
- Discussion on the TSNR project regarding the proposed changes to the data system and structure. How can odometer data be translated to post miles for safety screening in TSNR?

After reviewing this information and other relevant data, the authors conducted research to address the following:

- What are the proposed changes for the TSNR project?
- How will these changes affect the current data structure? Are there any shared attributes?
- Will these change impact the SPF tool? If so, will the elements be impacted? And how can the tool be made compatible with these changes?

This report answers the above questions. A quick overview about the current status of TSN as well as the TSNR project are also covered. Additionally, the data structure for advanced safety analysis developed as part of this project is provided.

The following chapters outline the tasks conducted for this study. Chapter 2 describes the existing Transportation System Network and ongoing transition to TSNR within Caltrans. Chapter 3 explains how the TSNR affects the SPF tool in safety analysis. Chapter 4 describes the proposed data structure for advanced safety analysis using safety performance functions for network screening. Chapter 5 discusses the performance measures used in the safety evaluation. Chapter 6 presents conclusions. Appendix A contains data structure with technical specifications for safety screening and advanced safety studies.

Chapter 2. Understanding the Transportation System Network

Prior to designing a database structure for network screening to be compatible with the SPF tool developing as part of the SPF implementation project, it is important to understand the current TSN as well as the TSNR project. This chapter summarizes the different types of variables and formats available in TASAS-TSN and the ongoing TSNR project. We reviewed the current data structure that was shared with us, and a draft TSN replacement project road map, as well as a report on the TSNR effort as-is process deliverable submitted by Visionary Integration Professionals to Caltrans. We also had discussions with the Caltrans advisory committee as well as with other experts to better understand the ongoing transition as part of the TSNR project.

This summary focuses on the variation in the documentation of the current TASAS-TSN system which includes an infrastructure database for the three facility types—highway, intersection and ramp. The following section describes the types of important information relevant to the infrastructure and collision data requirements, while the Appendix summarizes the data structure.

2.1. Current TSN

The current TSN is the departmental database used to maintain and link traffic census, collision, and highway inventory data for the state highway system (SHS). The TASAS branch also maintains data in the TSN database for all collisions which occur on, or are associated with, a State highway facility. Combining the highway inventory and collision data allows Caltrans to identify highway locations for investigation through safety investigations. Two data structures for the three facility types are currently available in the TSN as follows:

- Infrastructure data
    - Highway
    - Intersection
    - Ramp
- Collision data

2.2. Infrastructure data

Infrastructure data includes location information, geometric or design characteristics, traffic volume and additional characteristics for all three facility types; highway, intersection and ramp. This information varies according to facility type and is explained in the following sections.

2.2.1. Highway

Highway segment infrastructure data requirements includes location information such as district, county, route (including suffix if any) and post mile (including prefix and suffix, if any). The primary geometric characteristics of the highway includes number of lanes, shoulder type and width, median type and width, travel way width, length of segment and functional class, while average daily traffic (ADT) is considered as the traffic volume. In addition to these details, information on highway group, population group, lighting condition, break description, and operation characteristics are also provided.

2.2.2. Intersection

Intersection infrastructure data is most likely same as that for the highway with limited additional information on cross streets. Infrastructure data includes district, county, route (including suffix if any) and post mile (including prefix and suffix, if any) of the mainline. Geometric characteristics, traffic volume and additional features includes mainline as well as cross street.

2.2.3. Ramp

In the case of ramp infrastructure data, location information is similar to highway and intersection data structure, while design characteristics include on/off ramp type and design type. Additional information includes highway group and population code.

2.3. Collision data

Collision data structure includes location information such as district, county, route (including suffix if any) and post mile (including prefix and suffix, if any). To represent facility type in the collision data, there is a field named 'file type.' In addition to these data, collision description including date and time, lighting condition and severity level are also provided.

2.4. Ongoing-Transition TSNR

Caltrans proposes to implement a new Transportation System Network Replacement (TSNR), which integrates geospatial information required by MAP-21 and the FAST Act, and which also addresses current TSN system performance. The TSNR also proposes to include safety data and to support advanced safety analysis through network screening. The Moving Ahead for Progress in the 21st Century Act, (MAP-21), was signed into law in 2012, and this federal regulation requires that states have a safety data system in place that can be used to analyze supporting strategic and performance goals. This applies to California and the state's Strategic Highway Safety Plan and Highway Safety Improvement Program. The new law also requires that states use their safety data systems to identify fatalities and serious injuries on all public roads by location, and specifies that states have the capability to link crash, roadway, and traffic data by geolocation. The current TSN application does not integrate geospatial information as required by the new federal law. Additionally, the TSN architecture has limited sustainability, lacks a flexible reporting function, is not user-friendly, and does not integrate well with other departmental programs and systems.

After reviewing the draft TSNR roadmap and the discussion on the TSNR project on June 29, 2018, the following questions were compiled:

- What is the appropriate base referencing system to conduct safety screening: post mile or odometer?
- How the current SPF Tool can be compatible with the LRS system?
- How can the odometer data be translated to post miles?

2.5. Shared Attributes

After reviewing the current TSN data structure and proposed TSNR, both data structures were found to include post mile. Even odometer data can be easily translated to post mile using an existing tool within Caltrans, since collisions generally use post mile as a reference point. The other variables/names of the variables will be in line with the MIRE dictionary, and additional geometric characteristics of the infrastructure will be added to the TSNR for advanced safety analysis.

Chapter 3. Proposed Database Structure

Using the information described in Chapter 2, database structures were proposed after reviewing TSN and TSNR from an advanced safety analysis point of view. The proposed infrastructure data structure can accommodate different types of geometric characteristics that are useful for safety analysis and identifying the high crash concentration locations (HCCL). The infrastructure database structure is designed to incorporate location and geometric features with different levels of aggregation. In addition, the recommended structure is flexible enough to capture additional infrastructure features such as horizontal and vertical alignment characteristics, and ramp length in the infrastructure data as well as to add ramp collision location in the collision data.

3.1. Required Structure for Infrastructure Database

3.1.1. Highway

The proposed infrastructure data structure for highway is similar to the existing structure, with additional features including functional class and begin and end date of the segment to identify active segments. Any additional fields/attributes such as alignment information must be recorded in the TSN based on technical specification to maintain compatibility with the SPF tool. The key variables for this data structure are *county, route, route suffix, post mile prefix, begin post mile, end post mile* and *post mile suffix*.

3.1.2. Intersection

In the case of proposed intersection data structure, new location information was identified, including begin and end information for county, route, route suffix, post mile prefix, post mile, and end post mile based on the override length, in addition to main location information. The key variables for this data structure are *begin county, begin route, begin route suffix, begin post mile prefix, begin post mile, begin post mile suffix, main county, main route, main route suffix, main post mile prefix, main post mile, main post mile suffix, and end county, end route, end route suffix, end post mile prefix, end post mile,* and *end post mile suffix.*

3.1.3. Ramp

The proposed ramp infrastructure data is similar to the existing structure with the addition of ramp description. In this case ramp collisions are marked as point locations, since the length of the ramp is unknown. Any additional fields/attributes such as ramp length must be recorded in the TSN based on technical specification in order to maintain compatibility with the SPF tool. The key variables for this data structure are *county, route, route suffix, post mile prefix, post mile,* and *post mile suffix.*

Table 1. Highway infrastructure data structure for safety analysis

Table 2. Intersection infrastructure data structure for safety analysis

Table 3. Ramp infrastructure data structure for safety analysis

3.2. Required Structure for Collision Database

The proposed collision data structure is shown in Table 4. This includes location information, facility type, date and time of collision, highway group, population code, and severity level. To guide investigators as they examine the state highway system (SHS), each collision is assigned one of five levels of collision severity: fatal, severe injury, visible injury, complaint of pain, and property damage only. This also assists in providing countermeasures and developing crash modification factors, as well as advanced safety screening of highways. The key variables for this data structure are *county, route name, route suffix, post mile prefix, post mile, post mile suffix, accident date* and the *accident time*.

Table 4. Collision data structure for safety analysis

Chapter 4. Elements of the SPF Tool

This chapter describes an overview of the enhanced SPF tool, and the stages of safety analysis using this tool. In addition, the tool elements that will be impacted and the modifications made to the tool to accommodate the changes due to the TSNR are described.

4.1. Stages in the Enhanced SPF Tool

This section provides descriptions of the different stages of the network screening using the SPF tool and how these stages will be impacted by the proposed TSNR. The flowchart of the SPF tool process is shown in Figure 1. The SPF tool comprises three stages as follows:

- Data Input
- Data Analysis
- Report Generation

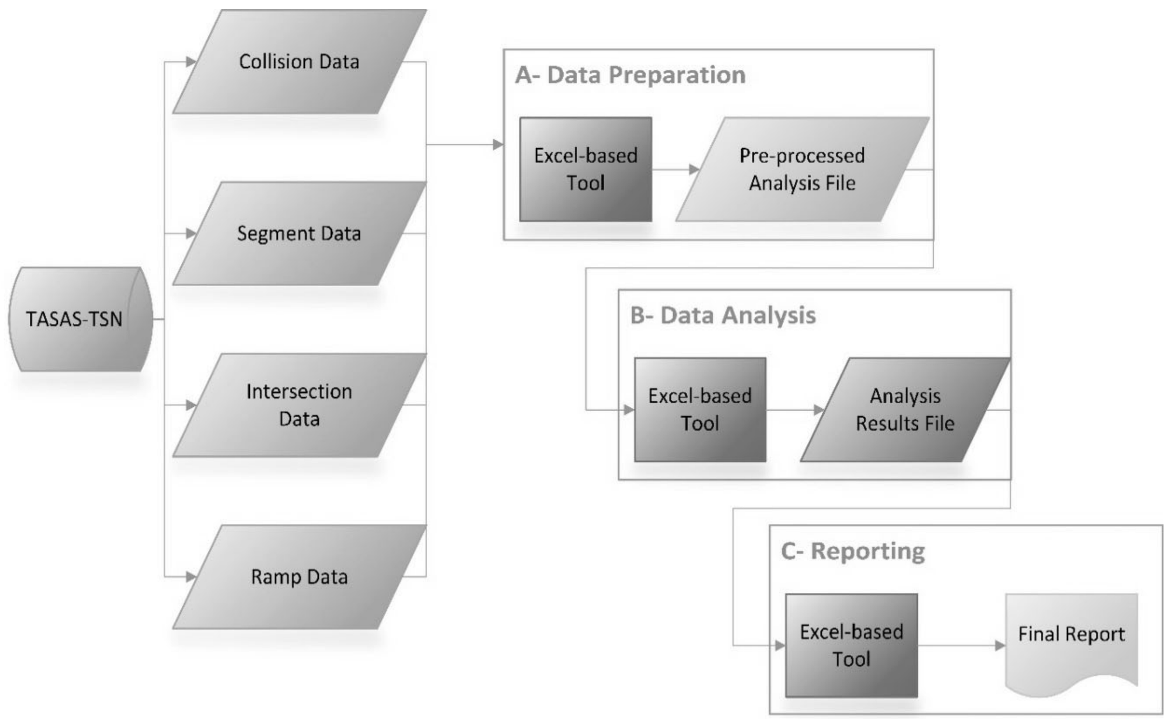

Figure 1. Flowchart of SPF Tool

4.1.1. Data Input

As shown in Figure 1, data input is the first stage of the SPF tool process. The data required for network screening safety analysis includes the three facility type infrastructure data and the collision data proposed in Chapter 3. Any missing data input may lead to erroneous identification of high crash concentration locations for investigation.

- Four TASAS data files (CSV format for analysis period):
    - Three infrastructure data files: segment, intersection and ramp
    - One collision data file

This stage involves the following steps:

1. Identify unique facilities based on the active segments.
2. Standardize updates based on the years of analysis.
3. Estimate intersection influence distance based on the override length in the intersection data file.
4. Merge infrastructure and collision data files based on the post mile.

The output from this stage is the summary tables for the imported infrastructure and collision data.

4.1.2. Data Analysis

Once the data have been imported, the next stage in the SPF tool process is the review of the analysis period, which involves the following steps:

- Select the PSI threshold
  - By ranking (100, 200, 300,400 & 500)
  - By percentage (1% & 5%)
- Network Screening (Select one detection method)
  - Sliding Window
  - Peak Searching
  - Select window length (0.1 – 1.0, with an increment of 0.1)

The stage will generate an Excel sheet with list of locations based on potential for safety improvement (PSI).

4.1.3. Report Generation

This stage will generate a report after analysis based on user needs.

- List of locations based on PSI threshold
  - PDF format
  - List differs based on the PSI threshold
  - Can be generated at districtwide or statewide level
- TIRTS format
  - CSV format
  - To upload in the Traffic Investigation Report Tracking System (TIRTS)
  - Compatible with TIRTS format

4.2. Formats

All of the data structures required for the analysis should be in CSV format. The tool has been designed to be compatible solely with this format, and all other file formats will be excluded due to difficulty of processing using the tool.

Chapter 5. Performance Evaluation

Network screening is practice of using analytical techniques to identify high crash concentrated locations along the Caltrans SHS that have more crashes than expected. This chapter describes the performance evaluation measures that can be used to compare the performance of state-of-the-practice network screening methods. As part of the study, suitability of performance measures for network screening approach such as Sliding Window and Peak Searching being implemented within the SPF Tool based on the previously deployed metrics in the literature and developed were discussed. Suggestion of these measures will allow Caltrans to better take advantage of identifying high crash concentration location for improving safety along the SHS.

5.1. Network Screening Approach

The two most commonly used network screening approaches are the sliding window method and the peak searching method. These two approaches are included in the tool for network screening of the Caltrans State Highway System (SHS) and for performance evaluation purposes when requested by the agency. The sliding window and peak searching approaches used for safety evaluation of highway segments are described below.

5.1.1. Sliding Window

Using the sliding window method, a window of a specified length is conceptually moved along the road segment from beginning to end in increments of a specified size (Figure 2). The performance measure chosen to screen the segment is applied to each position of the window, and the results of the analysis for each window are recorded.

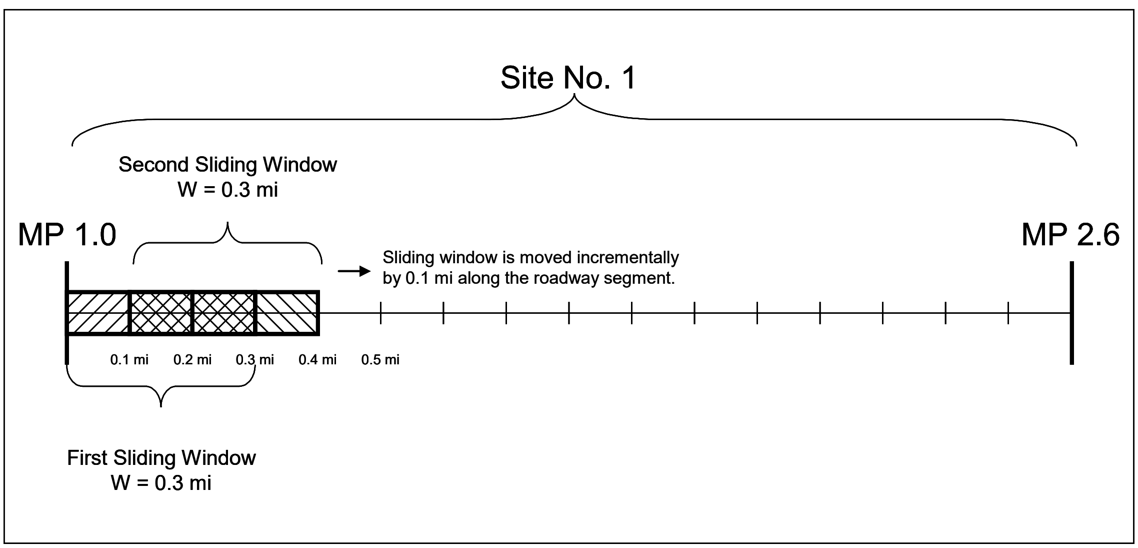

Figure 2: Schematic diagram of the Sliding Window approach

A window pertains to a given segment if at least some portion of the window is within the boundaries of the segment. Among all windows that are included in a given segment, the window that shows the most potential for reduction in crash frequency is identified and is used to represent the potential for reduction in crash frequency of the entire segment. After all segments are ranked according to the respective highest sub-segment value, those segments with the greatest potential for reduction in crash frequency or severity are studied in detail to identify potential countermeasures (HSM 2010).

5.1.2. Peak Searching

Peak searching is a method used to identify the segments that are most likely to benefit from a safety improvement within a homogeneous section. Based on the Highway Safety Manual 2010, application of the peak searching method involves each individual roadway segment being subdivided into windows of similar length, potentially growing incrementally in length until the length of the window equals the length of the entire roadway segment (Figure 3). Windows do not span multiple roadway segments. For each window, the chosen performance measure is calculated.

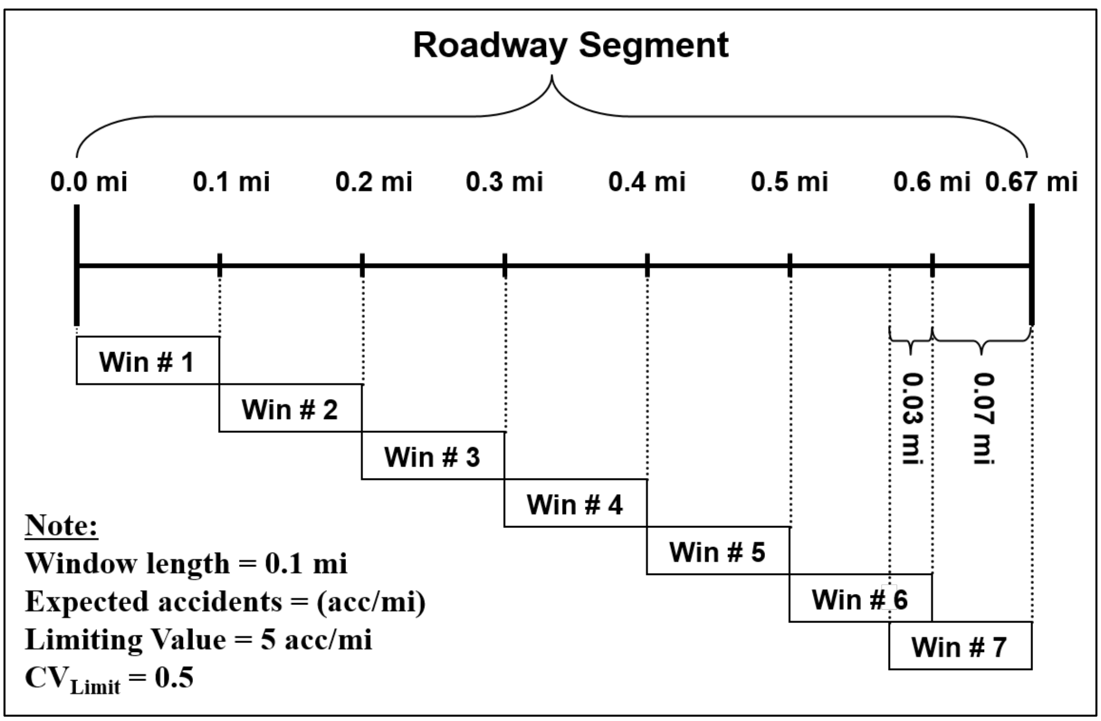

Figure 3: Schematic diagram of the Peak Searching approach

Based upon the statistical precision of the performance measure, the window with the maximum value of the performance measure within a roadway segment is used to rank the potential for reduction in crashes of that site (i.e., entire roadway segment) relative to the other screened sites.

5.2. Goodness-of-fit Measures

Measures used to evaluate the performance of the models include mean absolute deviation, mean squared prediction error, and root mean square error, as described below.

5.2.1. Mean Absolute Deviation

The mean absolute deviation (MAD) of a set of data is the average distance between each data point and the mean value of the data set. MAD presents the difference in prediction of the models in an absolute format, as given by Eqn. (1). A value closer to zero shows that the model will perform well, when compared with the observed data.

$$\text{MAD} = 1/n\sum_{i=1}^{n}\left|x_i - \bar{x}\right| \tag{1}$$

5.2.2. Mean Squared Prediction Error

The mean square percentage error (MSPE) is a measure of accuracy of the model in statistics, as given by Eqn. (2), and usually expresses error as a percentage.

$$\text{MSPE} = 1/n\sum_{i=1}^{n}\left|\frac{x_i - \bar{x}}{x_i}\right|^2 \tag{2}$$

Where, ‘ x_i ’ denotes the i^{th} individual value and ‘$\bar{x}$’ is the mean value.

5.2.3. Route Mean Square Error

The root-mean-square error (RMSE) is a frequently used measure of the differences between values (sample or population values) predicted by a model or an estimator and the values observed.

Chapter 6. Conclusion

The purpose of this study is to enhance the SPF tool developed as part of the SPF Implementation study, to be compatible with the Transportation System Network Replacement (TSNR) project. Based on the understanding of the shared attributes between TSN and TSNR, a new data structure for infrastructure and collision is proposed for advanced safety analysis. This research provides Caltrans with an enhanced assessment of their existing safety-related infrastructure databases with a recommended data dictionary to improve data quality through future updates/data collection. In addition, the data dictionary will serve as a guideline for data structure required for highway safety projects and the resolution required for analysis. Finally, additional features were added to the tool based on the understanding of the ongoing transition from TASAS-TSN to TSNR, in addition to the magnitude with which it can be easily integrated into the Caltrans database. The findings from this project will allow Caltrans to maximize available resources across various highway safety-related projects to achieve better SPF models in the future. In the long term, including following completion of the TSNR transition, Caltrans will be able to use the SPF tool to identify high collision concentration locations through network screening that will ultimately lead to a reduction in traffic-related injuries and fatalities on the California State Highway System.

References

Draft TSNR Project Roadmap_Ver4 from California Department of Transportation

Meeting to discuss Traffic Ops concerns on the current Caltrans LRS regarding safety analysis, Caltrans, June 29, 2018

Transportation System Network Reassessment (TSNR), Effort As-Is Process deliverable, Caltrans

Highway Safety Manual 2010, AASHTO, 1st edition

Appendix A – Data Structure with Technical Specifications for Safety Screening and Future Safety Studies

I. Infrastructure Data

This section provides infrastructure data structure for safety screening for all three facility types: highway, intersection, and ramp.

Table 1: Highway Infrastructure Data Structure for Safety Analysis

Field Name	Description
SPFH_DISTRICT	District number segment belongs
SPFH_COUNTY	County code
SPFH_ROUTE	Route number
SPFH_RTE_SFX	Route suffix
SPFH_PM_PFX	Post mile prefix
SPFH_BEGIN_PM	Begin post mile
SPFH_END_PM	End post mile
SPFH_PM_SFX	Post mile suffix
SPFH_HIGHWAY_GROUP_CODE	Highway group
SPFH_LENGTH_MILES_AMT	Length of segment in miles
SPFH_ADT_AMT	Average daily traffic
SPFH_POPULATION_CODE	Population
SPFH_TERRAIN_CODE	Terrain
SPFH_DESIGN_SPEED	Design speed
SPFH_BREAK_DESC	Break description (End/Begin of District/County/ Route)
SPFH_EQUATE_CODE	Equate code
SPFH_RT_LANES_AMT	Right side - Number of lanes
SPFH_RT_SURF_TYPE_CODE	Right side - Surface type
SPFH_RT_TRAV_WAY_WIDTH	Right side - Travel way width
SPFH_RT_I_SHD_TOT_WIDTH	Right side - Inner Shoulder total width
SPFH_RT_O_SHD_TOT_WIDTH	Right side - Outer Shoulder total width
SPFH_MEDIAN_BARRIER_CODE	Median barrier
SPFH_MEDIAN_TYPE_CODE	Type of median

SPFH_MEDIAN_WIDTH	Width of median
SPFH_MEDIAN_WIDTH_VAR_CODE	Median width code
SPFH_LT_LANES_AMT	Left side - Number of lanes
SPFH_LT_SURF_TYPE_CODE	Left side - Surface type
SPFH_LT_TRAV_WAY_WIDTH	Left side - Travel way width
SPFH_LT_I_SHD_TOT_WIDTH	Left side - Inner Shoulder total width
SPFH_LT_O_SHD_TOT_WIDTH	Left side - Outer Shoulder total width
SPFH_R_ODOMETER_BEGIN	Right side - Begin Odometer reading
SPFH_R_ODOMETER_END	Right side - End Odometer reading
SPFH_L_ODOMETER_BEGIN	Left side - Begin Odometer reading
SPFH_L_ODOMETER_END	Left side - End Odometer reading
SPFH_BEGIN_DATE	Begin date (Depends on the analysis period)
SPFH_END_DATE	End date (Depends on the analysis period)
SPFH_EXTRACT_DATE	Data extraction date
SPFH_SEG_ORDER_ID	Segment Order ID
SPFH_BEGIN_OFFSET_AMT	Begin Offset
SPFH_RATE_GROUP	Highway Rate Group
SPFH_RATE_GROUP_DESC	Highway Rate Group Description
SPFH_ACCESS_CODE	Highway Access
SPFH_ACCESS_CODE_DESC	Highway Access Description
SPFH_LANDMARK_SHORT_DESC	Highway Landmark

Table 2: Intersection Infrastructure Data Structure for Safety Analysis

Field Names	Description
SPFI_DISTRICT	District
SPFI_COUNTY	County
SPFI_ROUTE	Route
SPFI_RTE_SFX	Route suffix
SPFI_MAIN_BEGIN_PM_PFX	Mainline Begin Post mile Prefix
SPFI_MAIN_BEGIN_PM	Mainline Begin Post mile (Buffer)
SPFI_MAIN_BEGIN_PM_SFX	Mainline Begin Post mile Suffix
SPFI_MAIN_PM_PFX	Mainline Post mile Prefix
SPFI_MAIN_PM	Mainline Post mile
SPFI_MAIN_PM_SFX	Mainline Post mile Suffix
SPFI_MAIN_END_PM_PFX	Mainline End Post mile Prefix

SPFI_MAIN_END_PM	Mainline End Post mile (Buffer)
SPFI_MAIN_END_PM_SFX	Mainline End Post mile Suffix
SPFI_HIGHWAY_GROUP	Highway Group
SPFI_CITY_CODE	City
SPFI_POPULATION_GROUP	Population
SPFI_DESIGN_CODE	Intersection Design
SPFI_DESIGN_DESC	Intersection Design Description
SPFI_DESIGN_DATE	Date of Design
SPFI_LIGHTED_IND	Presence of Light Condition at
SPFI_LIGHTED_BEGIN_DATE	Begin date of Light Condition at
SPFI_MAIN_SIGNAL_MAST_ARM_IND	Presence of Mainline Mast Arm Signal
SPFI_MAIN_LEFT_CHANNEL_CODE	Presence of Mainline Left Channel
SPFI_MAIN_RIGHT_CHANNEL_CODE	Presence of Mainline Right Channel
SPFI_MAIN_FLOW_CODE	Mainline Flow description
SPFI_CROSS_SIGNAL_MAST_ARM_IND	Presence of Cross street Mast Arm Signal
SPFI_CROSS_LEFT_CHANNEL_CODE	Presence of Cross street Left Channel
SPFI_CROSS_RIGHT_CHANNEL_CODE	Presence of Cross street Right Channel
SPFI_CROSS_FLOW_CODE	Cross street Flow description
SPFI_CONTROL_CODE	Intersection Control Condition
SPFI_CONTROL_DESC	Intersection Control Condition Description
SPFI_CONTROL_DATE	Intersection Control Condition Begin date
SPFI_MAIN_LANES_AMT	Mainline - Number of lanes
SPFI_MAIN_OVERRIDE_LENGTH_AMT	Mainline - Override length (Buffer)
SPFI_CROSS_LANES_AMT	Cross street - Number of lanes
SPFI_CROSS_OVERRIDE_LENGTH_AMT	Cross street - Override length
SPFI_MAINLINE_ADT	Mainline - Average Daily Traffic
SPFI_X_ROUTE	Cross street route number
SPFI_X_RTE_SFX	Cross street route number suffix
SPFI_X_BEGIN_PM_PFX	Cross street begin post mile prefix
SPFI_X_BEGIN_PM	Cross street post mile
SPFI_X_BEGIN_PM_SFX	Cross street begin post mile suffix
SPFI_X_PM_PFX	Cross street post mile prefix
SPFI_X_PM	Cross street post mile
SPFI_X_PM_SFX	Cross street post mile suffix
SPFI_X_END_PM_PFX	Cross street end post mile prefix

SPFI_X_END_PM	Cross street post mile
SPFI_X_END_PM_SFX	Cross street begin post mile suffix
SPFI_XSTREET_ADT	Cross street - Average Daily Traffic
SPFI_R_BEIN_ODOMETER	Mainline Right-side begin odometer
SPFI_R_ODOMETER	Mainline Right-side odometer
SPFI_R_END_ODOMETER	Mainline Right-side end odometer
SPFI_L_BEGIN_ODOMETER	Mainline Left-side begin odometer
SPFI_L_ODOMETER	Mainline Left-side odometer
SPFI_L_END_ODOMETER	Mainline Left-side end odometer
SPFI_X_R_BEIN_ODOMETER	Cross street Right-side begin odometer
SPFI_X_R_ODOMETER	Cross street Right-side odometer
SPFI_X_R_END_ODOMETER	Cross street Right-side end odometer
SPFI_X_L_BEGIN_ODOMETER	Cross street Left-side begin odometer
SPFI_X_L_ODOMETER	Cross street Left-side odometer
SPFI_X_L_END_ODOMETER	Cross street Left-side end odometer
SPFI_SKEW_ANGLE	Intersection skew angle
SPFI_MAIN_LANE_FUN_CLASS	Main lane functional class
SPFI_MAIN_LANE_WIDTH	Width of main lane
SPFI_CROSS_STREET_WIDTH	Width of cross street
SPFI_BEGIN_DATE	Begin date of intersection update
SPFI_END_DATE	End date of intersection update
SPFI_EXTRACT_DATE	Data extraction date
SPFI_SEG_ORDER_ID	Mainline segment order ID
SPFI_X_SEG_ORDER_ID	Cross street segment order ID
SPFI_RATE_GROUP	Intersection rate group
SPFI_RATE_GROUP_DESC	Intersection rate group description
SPFI_INTERSECTION_NAME	Name of the intersection

Table 3: Ramp Infrastructure Data Structure for Safety Analysis

Field Names	**Description**
SPFR_DISTRICT	District
SPFR_COUNTY	County
SPFR_ROUTE	Route
SPFR_RTE_SFX	Route suffix
SPFR_PM_PFX	Post Mile prefix

SPFR_PM	Post Mile
SPFR_PM_SFX	Post Mile Suffix
SPFR_DESIGN_DESC	Ramp Design Description
SPFR_ON_OFF_CODE	ON/OFF Ramp
SPFR_CITY_CODE	City
SPFR_ADT	Ramp Average Daily Traffic
SPFR_POP_GROUP	Population group
SPFR_HIGHWAY_GROUP	Highway group
SPFR_R_ODOMETER	Right-side Odometer
SPFR_L_ODOMETER	Left-side Odometer
SPFR_RAMP_LENGTH	Length of ramp
SPFR_RAMP_LANES_AMT	Number of lanes in ramp
SPFR_RAMP_LANE_WIDTH	Width of lane
SPFR_ORDER_ID	Order ID
SPFR_RATE_GROUP	Rate group code
SPFR_RATE_GROUP_DESC	Rate group description
SPFR_BEGIN_DATE	Begin date of update
SPFR_END_DATE	End date of update
SPFR_EXTRACT_DATE	Data extraction date
SPFR_RAMP_DESCRIPTION	Ramp description

II.Collision Data

Table 4: Collision Data Structure for Safety Analysis

Field Names	**Description**
ACCIDENT_YEAR	Year accident occurred
ACCIDENT_NUMBER	Accident number
DISTRICT	District accident occurred
COUNTY	County code within district
COUNTY_NAME	County name within district
CITY	City code within county
CITY_NAME	City name within county
ROUTE_NAME	Route name within the county
ROUTE_SUFFIX	Route suffix
PM_PREFIX	Prefix to the post mile

POSTMILE	Post mile
PM_SUFFIX	Suffix to the post mile
FILE_TYPE	Facility type – highway/intersection/ramp
ACCIDENT_DATE	Accident date
ACCIDENT_TIME	Accident time
COMMON_ACCIDENT_NUMBER	Combination of jurisdiction, badge ID, date
PRIMARY_COLL_FACTOR	Primary collision factor
SEVERITY_LEVEL	Level of severity of accident